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The Implications of the Incursion of Cryptocurrency on the Effectiveness of Fiscal Policy

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Abstract. *Existing literature has examined a plethora of factors that can affect the effectiveness, performance, or nature of fiscal policy in an economy. In this paper, we build on the fundamental tenets of micro-economic models to examine the potential ways cryptocurrencies can affect the effectiveness of a country's fiscal policy. Our finding is that under the assumptions of an absence of uncertainties, perfectly competitive markets, household utility maximization, and usage of public money and cryptocurrency, the government purchases as well as the ability of the government to raise funds by issuing bonds and by taxation is decreasing in new investments in cryptocurrencies but increasing in the income earned from cryptocurrencies. We go further to discuss the factors that account for the sustained ability of cryptocurrencies to weaken the state's fiscal-policy capabilities and possible ways the effects of cryptocurrencies on the state's fiscal integrity can be mitigated.*

Keywords: Cryptocurrency, Effectiveness, Fiscal Policy, Micro-economic models, Technology.

JEL Codes: E62, F36, F65

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1. Introduction

Over the last few decades, several private monies have been issued both by identifiable, regulated organizations as well as by invisible, unidentifiable, and unregulated institutions in most major economies across the globe. For the sake of clarity and precision, we will provide a working definition of private money or cryptocurrency as we will use private money and cryptocurrency interchangeably in this paper. Private money or cryptocurrency is a widely accepted digital instrument of payment, medium of exchange, or store of value supplied by a non-governmental organization devoid of any guarantees from the state or any legal privileges (Dowd, 2014). Experience proves that a necessary and sufficient condition for an instrument to be accorded the status of private money is widely accepted even though it may not command a general acceptance. In other words, for a currency to stand the test of time, it must attract and maintain a critical mass of users (Dowd, 2014). The predominant and most renowned cryptocurrency is Bitcoin (Binance Capital management, 2021). From this same platform, we can also infer those other notable cryptocurrencies such as Ethereum and Tether. It has been recounted in public media that Facebook made an entry into the

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cryptocurrency industry with the launching of 'Libra' (Chatenay, 2021). This heterogeneity of interests has been reflected in the capitalization of the cryptocurrencies market, which has grown exponentially from around 19 billion dollars in February 2017 to over 2.4 trillion dollars in December 2021 (Binance Capital management, 2021). Also, there are approximately 8500 cryptocurrencies in existence and actively trading.

Over the years, the demand, acceptance, and use of private money have been building up in leaps and in bounds for several reasons. Most notable of which include the credence that cryptocurrencies will not deteriorate in value or purchasing power; the resentment against galloping governmental control of economic and financial behaviour; and the conviction that it can generate returns superior to state money (Dowd, 2014). While several regulatory institutions have made efforts to thwart the success of certain private monies, a good number continue to exist with their triumph, aided by the rise of internet technology. A case in point is Bitcoin. Bitcoin is a totally decentralized digital currency and system of money creation or issuance that would be challenging for law enforcement institutions to truncate given that it is not associated with any 'point of failure'. Bitcoin is churned out in the course of a 'digital mining' process that is typified by constrained supply in a way that is significantly comparable to the gold-standard monetary policy regime. In a similar manner to other cryptocurrencies, Bitcoin can compete with state money, restoring financial privacy as well as creating a stable crypto-turbulent communal order that would be operational in a manner that is sufficiently beyond the whims and caprices of any governmental force (Dowd, 2014). Having a full grasp of private money, the ramifications of its impact and reach becomes very crucial, especially for unregulated or loosely regulated cryptocurrencies that have been emerging spontaneously through market forces and growing prodigiously as well as operating outside the control of the state. It is against this backdrop that we wish to demonstrate in this paper that in an environment where private monies are beyond the reach of government regulations or are allowed to freely coexist with state money, it has the potential to erode the ability of the state to utilize its fiscal policies to stabilize fluctuations typical of business cycles in an economy. We will show this theoretically by building on the basic tenets of the micro models in economics and incorporating some modifications.

2. Research Elaboration: Literature Review

Many authors have immensely espoused the enormous literature on fiscal policy and the growing literature on cryptocurrency in many distinct ways. This paper is differentiated from this vast literature on fiscal policy, in addition to those on private money by seeking to demonstrate a nexus between cryptocurrencies and the usefulness of the fiscal policy of a nation. In this paper, we strive to contribute to both the literature on fiscal policy as well as in private money. In the ensuing paragraphs, we will summarize some of the most important works within the fiscal policy as well as in private money, and ultimately, we will precisely specify how this paper would differ from and contribute to the existing literature in both fields of endeavour.

2.1. Fiscal Policy

Amid the overwhelming body of literature on the ramification of fiscal policy, we will review some of the most prominent strands. An incredibly large chunk of studies examines the consequences of fiscal policy on economic output under various circumstances and in distinct economies. Lotz (1970) proposed a model for evaluating the impact of fiscal policy on economic output in developing economies. Rao (1975) presents a neoclassical two-sector model that examines the economic impact of fiscal policy on output growth. Tanzi and Zee (1997) summarize that fiscal policy could be a core determining factor for the long run economic growth performance of countries. Gemmell, Kneller, and Sanz (2011) demonstrated that previously

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forecasted long-run growth consequences of fiscal policy are generally generated rapidly in line with outcomes elicited by short-run models with persisting short-run consequences.

Recent research reveals the circumstances under which and the degree to which a fiscal multiplier could respond to variations in government expenditure. Gali, Lopez-Salido, and Valles (2007) perceived the possibility for a fiscal multiplier to be enormous if the ratio of non-Ricardian consumers is big and policies for stimulating the economy perform fundamentally by way of the consumption channel. Leeper, Traum, and Walker (2017) demonstrate that fiscal multipliers might be steadfastly high if the expenditure of the government interrelates positively with consumer choices.

Modern theoretical research calls attention to prospective channels through which nonlinear propagation of fiscal policy shocks can occur. Michaillat (2014) demonstrates that public employment might have much greater multiplier effects in situations in which the unemployment rate is high than in circumstances in which it is low. In the studies undertaken by Canzoneri, Collar, Dellas, and Diba (2016), it can be understood that the role of the credit channel when credit constraints are not only infrequently binding but also endogenous in supporting the propagation of fiscal policy shocks can be substantial. Barnichon and Matthes (2017) observe that government expenditure depletion has greater impacts than increments and noted that the outcomes were propelled fundamentally by overly robust unfavourable reactions of output to government expenditure reductions during recessions. Jones, Olson, and Wohar (2015) demonstrate that tax cuts create tremendous favourable results for output in the United States, while tax increments have no tremendous unfavourable impacts, nevertheless, these outcomes are contradicted in the UK. Guajardo, Leigh, and Pescatori (2014) as well as Jorda and Taylor (2016) observe big reductions in output in reaction to exogenous fiscal consolidations. Alesina, Favero, and Giavazzi (2015) observe over 30 years that for 16 OECD nations, fiscal adjustments premised on expenditure reductions are cheaper by way of output forfeiture than adjustments premised on tax increments. McManus, Ozkan, and Trzeciakiewicz (2018) demonstrated that the credit channel if credit constraints are not only infrequently binding but also endogenous in supporting the propagation of fiscal policy shocks can be substantial.

There are strands of theoretical and empirical economic research that study the factors that can affect the performance, effectiveness, or the nature of the fiscal policy. Conesa and Garriga (2008) demonstrated that the optimal design of a social security reform reflects significant welfare gains attributable to decreases in the distortion of labour supply. Lewis (2012) examined the ratings of public bonds for the period ranging from 1996 to 2009 and observed that term limits unfavourably affect a state's fiscal performance resulting in lower bond ratings. Goolsbee (2001) examined the effects of electronic commerce on fiscal policy and observed that the potential losses are modest over several years in the future. Kaminsky, Reinhart, and Végh (2004) examined a sample of 104 countries and observed the procyclicality of net capital inflows, the procyclicality of fiscal policy, and that eras of capital inflows are correlated with expansionary macroeconomic policies together with the finding that eras of capital outflows are associated with contractionary macroeconomic policies for most of developing nations. Our study is related to this strand of literature given that it examines a factor that can impact fiscal policy. And by examining how private money could likely interfere with the government's ability to impact the national output through the manipulation of fiscal policy, this differs from other factors that have been studied in contemporary economic research.

2.2. Private Money

Several authors have worked on exploring issues associated with the usage of cryptocurrencies in relation to regulations and regulatory frameworks. Trautman (2018) analyses the greater comprehension of the constant struggle of the law and regulations to keep pace with the speed of technological advancements. Seng and Yew (2015) explored the economics of the financial reporting of Bitcoin, applied accounting

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principles to the understanding of Bitcoin valuation, and strives to add value to the thinking process which may help accounting bodies issue an interpretation of Bitcoin reporting.

There also subsists an enlarging availability of published work that examines methodically the motivations, serviceability, and practicality of specific cryptocurrencies. Leshno and Strack (2020) designate Bitcoin as a payment system that fulfills the characteristics of uniqueness, confidentiality, and the absence of unreal identities. Garratt and Van Oordt (2019) examine how double-spending attacks can be eliminated by cryptocurrency particularly mining equipment. Biais, Bisiere, Bouvard, and Casamatta (2019) examine equilibria in consensus protocols of cryptocurrencies such as Bitcoin and research Bitcoin's acceptability as a payment system. Ebrahimi, Routledge, and Zetlin-Jones (2019) evaluate solid proof-of-work protocols for blockchain-based distributed ledgers, and Cong and He (2019) examine how competition could be affected by the presence of decentralized consensus that is implemented through the application of a distributed ledger technology. Prat and Walter (2018) forecast the computing capability of the Bitcoin network, by applying the Bitcoin-Dollar exchange rate. Huberman, Leshno, and Moallemi (2017) analyses the origination of revenue in the Bitcoin system.

There are strands of literature that examine the interaction between cryptocurrencies and monetary policy. Schilling and Uhlig (2018) focus on the potential outcome that can result from a cryptocurrency competing with public money. Fernández-Villaverde and Sanches (2016), as well as Chiu and Koeppl (2019), examine monetary policy and currency rivalry within the context of a Lagos-Wright framework. Benigno, Schilling, and Uhlig (2021) analysed a two-country economy characterized by a global cryptocurrency and two-state currencies, in a complete market and also emphasized the irreconcilability of the classic impossible trinity. In a different study, Benigno (2019) focused on a one-country model and perceived that given the existence of competition emanating from cryptocurrencies, the central bank can confront constraints on inflation and interest rates if the government currency continues to perform its role as a medium of exchange.

Despite these numerous publications on cryptocurrencies and fiscal policy, no effort has been made to demonstrate how private money could impact the capabilities of a government to implement its fiscal policies. Hence, we differ from the large swathe of studies above that have been conducted in both fiscal policy and private money by examining the consequences of cryptocurrency's unregulated existence on the government's fiscal policy. Our framework focuses on how an increase in the adoption of private money could trigger drastic consequences for a country's fiscal policy if no measures are instituted to curtail the growth in the dominance of cryptocurrencies.

3. Research Methodology and Models

3.1 General Framework:

We analyse an infinitely lived economy of a single country operating under perfect market conditions, featuring one state currency together with one unregulated cryptocurrency in the absence of uncertainties. The economy comprises many identical firms that are price takers and several identical households that are also price takers. The inputs required for production to take place include capital (K), labour (L), and technology (A). Output is divided among investments (I_t), private goods(C_t^p), and public goods(C_t^g). Labour and capital are paid their nominal prices. Firms seek to maximize profits and Households maximize their utility function from the consumption of a fraction of the output of the economy. Payments to factors of production are implemented in the national currency while returns can be earned in investments in both the

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state money and the unregulated cryptocurrency. Public goods result from government's expenditure, which the government finances by imposing lump-sum taxes and issuing bonds.

3.2 Assumptions:

Assumption 1 – Behaviour of Firms

We assume that the market for private goods is characterized by perfect competition. Therefore, firms are identical, make zero economic profits, and are price takers. The representative firm hires labour and capital to produce a good, Y_t, the price of which is P_t. Labour and capital are paid nominal wages, W_t, and nominal interest rate, R_t, respectively. The representative firm maximizes profits, π_t , in each period bounded by the constraints specified by the production function. Therefore, the following equation holds.

$$\pi_t = P_t Y_t - W_t L_t - P_t R_t K_t$$

The representative firm produces a good, Y_t , using the Cobb-Douglas production function, which is specified as follows:

$$Y_t = AK^{\alpha} L^{1-\alpha}, \quad 0 < \alpha < 1$$

Furthermore, we assume that technology or total factor productivity, A, is constant and the production function is increasing and concave.

Assumption 2 – Behaviour of Households

We make the following assumptions about the population, household, and labour supply. Households are homogenous. Households own the factors of production labour and capital and rent it out to firms on a period-by-period basis and receive compensations: a nominal wage, W_t, on unit labour supply, $L_t = 1$, and a nominal rent, R_t.

Households own firms and manage the firm's capital in consistency with the law of motion for capital. In other words, the household invests, I_t^k, to replenish the capital $\delta_t K_t$ that is lost through depreciation. Therefore, the following equation holds.

$$K_{t+1} = (1 - \delta_t)K_t + I_t^k$$

The Households' capital respects the "time to build" constraint. Therefore, Households' real return on capital can be expressed as follows: $1 + r_t = 1 + R_t - \delta_t$

Households also invest in the bonds issued by the government and in any given period t, the amount of bonds held is denoted by, B_t.

Households maximize their utility and the representative household maximizes the value of U $= \sum_{t=0}^{\infty} \beta^t u(C_t^p, C_t^g)$

Where, C_t^p = Demand for private goods, and C_t^g = Demand for public goods

u(•) is the specific or instantaneous utility function of the representative household

The population and the number of households are normalized to 1 and assumed to grow exogenously at the rate of 0. The labour supply is normalized to 1 and there is no disutility from working. Labour is perfectly divisible

The specific utility function, u(•), features two arguments, which are the demand for private goods and the demand for public goods. We assume an increasing and concave instantaneous utility function with constant relative risk aversion.

For simplicity, u(•) is a power utility function in the arguments:

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$u(C_t^i) = \sum_{i=0}^{n} \frac{1}{1-b} \left(C_t^i\right)^{1-b}$, where $b \geq 0$ and $b \neq 1$. Also i = (p,g)

Where, C_t^i= consumption or demand for private or public goods, P_t = Prices in period t

Assumption 3 – Fiscal Policy of the Government

Here, we make assumptions about the fiscal policies of the government. The government implements its fiscal policy through taxation, borrowing, making lump-sum transfers to the households, and making provisions for public goods. The public goods, C_t^g, and lump-sum transfers, X_t , are financed by lump-sum taxes, tW_tL_t , on wages earned by the household and by borrowing through the issuance of bonds, B_t. For the sake of simplicity, we assumed that taxes are levied only on wages. Public goods result from the government's purchases and are freely available to households.

The government is only able to levy taxes on the income earned in the national currency and can only issue bonds in the national currency. We make this assumption about taxes given available evidence about the growing challenges to the government's ability to tax income generated in cryptocurrencies. For example, the US treasury department reported that Cryptocurrency has indeed posed a major detection challenge by enabling unlawful transactions including tax evasion, and also reported that around 80% of the United States tax deficit is a result of underreported revenue, particularly amongst the very rich ones who hide their revenues in opaque structures (Lacurci, 2021). Therefore, we can specify the following equation for this economy. $C_t^g + X_t = tW_tL_t + B_t$

Assumption 4 – Private Money and Public Money

We make the following assumptions about private and public monies. In this economy, both the national currency and the cryptocurrency are applied in economic transactions and are also used for transferring wealth (assets and incomes) across periods. All wages are paid in the national currency and firms issue securities for raising capital in the national currency only.

The sum of households' nominal consumption, new asset holdings, and nominal money balances (of both private and public money) must be equal to the sum of their nominal incomes (in both private and public money), their initial asset holdings, and initial nominal money balances. We assume that the representative household must enter the period with enough nominal money balances of both private and public money to pay for consumption consistent with the cash-in-advance model. Given these assumptions, the following equation holds to be valid. $P_tC_t^p + M_{t+1} + m_{t+1} + B_{t+1} + P_tI_t^k = (1-t)W_tL_t + R_tP_tK_t + (1+r_t)B_t + M_t + (1 + rtm)mt \neq Xt$

We assume that private money can be converted into public money at a variable conversion ratio, n_t, such that: $n_tM_t = m_t$

Finally, we assume that the supply of private money or cryptocurrency, m, and public money, M, is given. The motivation for this assumption is to give room for abstracting from monetary policy issues and focus primarily on fiscal policy issues.

4. Results and Discussions

4.1 MAIN RESULTS

Proposition 1: Government purchases are decreasing with the increasing adoption of cryptocurrency

Assuming no uncertainties, perfectly competitive markets, household utility maximization, and usage of public money and cryptocurrency then the household optimal demand for public goods and by

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extension government purchases is decreasing in new investments in cryptocurrencies but increasing in the income earned from cryptocurrencies.

So, while a growing usage of cryptocurrency negatively impacts the government's fiscal policy capabilities, this effect can be potentially neutralized by the tendency of income earned in investments in cryptocurrency to have a favourable impact on the effectiveness of the fiscal policy. This is demonstrated in equation (C) below and the proof of which is available in the appendix. This is reasonable because a fraction of the income earned in cryptocurrencies finds its way back into the real economy and supports consumption and production and ultimately enhancing the government's revenue derivation from taxation. This kind of feedback loop ensures that the state's currency will remain the dominant currency. However, this can only be the case as long as firms pay wages and issue securities in the public currency. A development that can substantially hurt the stabilization capabilities of the government through fiscal policies is the onset of private firms' usage of cryptocurrencies to pay wages and raise capital to a significantly high degree.

$$C_t^g = \{(1-\alpha)P_tAK_t^{\alpha}L_t^{1-\alpha} + (\alpha AK_t^{\alpha-1}L_t^{1-\alpha} - \delta_t)P_tK_t + r_tB_t + r_t^m m_t - (m_{t+1}-m_t) - P_tK_{t+1} + P_tK_t\} - \left((P_t)^{\frac{b-1}{b}}\left[\frac{(W_tL_t + (1+r_t)P_tK_t + (2+r_t)B_t + (1+n_t)M_t + r_t^m m_t - M_{t+1} - m_{t+1} - B_{t+1} - P_tK_{t+1})}{\left((P_t)^{\frac{b-1}{b}}+1\right)}\right]\right) \quad (A)$$

Proposition 2: Government revenue generated through taxation and borrowing is decreasing with the increasing adoption of cryptocurrency

Assuming no uncertainties, perfectly competitive markets, household utility maximization, and usage of public and private money, then the revenue generated by a government through taxation and borrowing is increasing in income earned in the private money but decreases in new investments in cryptocurrencies.

This is true because government purchases are financed by revenue raised through taxation and the issuance of bonds. Thus, taxation and borrowing are positively correlated with government purchases. This is evident in equation (C) below and the proof of which is demonstrated in the appendix as previously stated.

$$C_t^g = \{(1-\alpha)P_tAK_t^{\alpha}L_t^{1-\alpha} + (\alpha AK_t^{\alpha-1}L_t^{1-\alpha} - \delta_t)P_tK_t + r_tB_t + r_t^m m_t - (m_{t+1}-m_t) - P_tK_{t+1} + P_tK_t\} - \left((P_t)^{\frac{b-1}{b}}\left[\frac{(W_tL_t + (1+r_t)P_tK_t + (2+r_t)B_t + (1+n_t)M_t + r_t^m m_t - M_{t+1} - m_{t+1} - B_{t+1} - P_tK_{t+1})}{\left((P_t)^{\frac{b-1}{b}}+1\right)}\right]\right) \quad (B)$$

Also, from equation (1) in the appendix, we have that: $C_t^g + X_t = tW_tL_t + B_t$

Thus,

$$tW_tL_t + B_t = \{(1-\alpha)P_tAK_t^{\alpha}L_t^{1-\alpha} + (\alpha AK_t^{\alpha-1}L_t^{1-\alpha} - \delta_t)P_tK_t + r_tB_t + r_t^m m_t - (m_{t+1}-m_t) - P_tK_{t+1} + P_tK_t\} - \left((P_t)^{\frac{b-1}{b}}\left[\frac{(W_tL_t + (1+r_t)P_tK_t + (2+r_t)B_t + (1+n_t)M_t + r_t^m m_t - M_{t+1} - m_{t+1} - B_{t+1} - P_tK_{t+1})}{\left((P_t)^{\frac{b-1}{b}}+1\right)}\right]\right) + X_t \quad (C)$$

4.2 DISCUSSIONS

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The acuteness of the potential problem posed by cryptocurrencies to the fiscal policies of nations cannot be overemphasized. The threat of cryptocurrencies to the integrity of a country's fiscal policy is sustainable because of the high usefulness of cryptocurrencies for tax evasion. Cryptocurrencies possess some of the most crucial nature of the archetypical tax haven. Firstly, they do not operate within the confines of any specific jurisdiction, and they are taxed at the source (Marian, 2013). In the second instance, enduring nature of cryptocurrency accounts is anonymity. The possibility of users maintaining an innumerable number of online "wallets" to mine or execute trades in Bitcoins devoid of ever furnishing any recognizing information remains solidly intact (Marian, 2013). Thirdly, the growing predominance of cryptocurrencies is for the most part not reliant on the presence of financial institutions including banks. Cryptocurrencies thus appear to be invulnerable to the emerging international tax anti-evasion programs. Overall, given the nature of cryptocurrencies, they possess the capabilities to turn out to be fantastic tax havens (Freeman, 2011).

One of the factors that account for a cryptocurrency's ability to facilitate tax evasion is lax reporting requirements, according to tax experts. It has been noted in the US that to the extent that the IRS falls short of tracing crypto-related transactions or income when such are not reported by organizations, businesses, exchanges, and other counterparties or third parties, there will be lost or unrecoverable taxation income (Lacurci, 2021). The need to remedy lax reporting becomes more crucial given that despite it being a relatively tiny proportion of business revenue at the moment, cryptocurrency dealings are bound to significantly rise in the next few years, particularly under the current broad-based financial account reporting regime (US Treasury report as cited by Marian, 2013). An additional factor that facilitates a cryptocurrency's capacity to weaken the state's tax collection abilities is that currently, existing anti-tax-evasion mechanisms do not possess the capabilities to successfully resolve cryptocurrency-based tax circumvention. As an instance, exchange-of-information treaties are not relevant, given that a cryptocurrency's operation has nothing to do with the presence of an autonomous jurisdiction. As with currently prevailing instances of offshore tax dodging, public authorities might apply intricate statistical scrutiny in an attempt to detect users of a cryptocurrency account. Nevertheless, Marian (2013) noted that such techniques are only suitable in specific cases and cannot represent a systematic approach to addressing the problem.

The second factor that accounts for the fact that the threat of cryptocurrencies to the integrity of a country's fiscal policy remains unwavering is that cryptocurrencies are endowed with the potential to motivate financial innovation, improve efficiencies by way of faster and cheaper payments and supplement financial inclusion (Chinoy, 2021). Other considerations that tend to sustain the tendency for cryptocurrency to be influential on fiscal policy encompasses the promotion of cryptocurrencies as a remedy to enduring challenges in financial ecosystems, ranging from financial inclusion to inter-bank settlements in the money market – even though minimal meticulous assessment of its fitness for purpose and feasibility has been implemented, Digital currency governance consortium compendium report (2021). Fortunately, the capabilities of any cryptocurrency appear to be limited, in addition to the fact that there are ways the threat of cryptocurrencies to fiscal policy can be mitigated. First and foremost, cryptocurrencies have inherent weaknesses. They are associated with infamous cases of fraud, operational catastrophes, and security fissures, together with allegations of its usage for illicit activities, He (2018). The result of my model demonstrates that there are positive feedback effects from increasing use of cryptocurrencies because if investors earn returns from cryptocurrencies, they inevitably have to channel a fraction back to the mainstream economy or the public currency. This kind of feedback loop ensures that the state's currency will remain the dominant currency.

Secondly, cryptocurrencies tend to be responsive to attempts by the government to curb its excesses. Auer and Claessens (2018) evaluated the actual behaviour of cryptocurrency markets in reaction to regulation and observed that notwithstanding the boundary-less and peer-to-peer characteristic of

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cryptocurrencies, regulatory measures and news of potential regulatory measures have a robust impact on the markets for cryptocurrency. Consistent with the idea of mitigating the threats of private money, the innovation inherent in the very nature of Bitcoin as a viable tool for tax evasion will necessitate pioneering policymaking. Marian (2013) elaborated on why remedies such as targeting business intermediaries that clear the way for transactions undertaken using Bitcoins may be apposite, even though there is uncertainty about the degree to which they can be implemented. Although there is an absence of involvement of traditional financial institutions in the exchange of cryptocurrencies, it appears that as cryptocurrencies continue to gain ground, some sort of web-based intermediaries will certainly arise across the market landscape. Likely, web sites that enable the exchange of cryptocurrencies to national legal tender would carry useful information about its account owners to make possible the exchange. The regulation of such intermediaries by the tax authorities applying the same approach by which they traditionally regulate financial intermediaries might be practicable. However, regulation is solely beneficial when cryptocurrencies can be exchanged for national currencies. Therefore, transactions that are completely executed in cryptocurrencies avoid such regulation. Theoretically, it is believed that in the event of cryptocurrencies gaining wide acceptance in a way that makes it possible for taxpayers to conduct the entirety of their daily transactions in a cryptocurrency, taxpayers could totally avoid national currencies and evade reporting income (Kashmir Hill, 2013). A Telegraph staff (2013) hinted that the German government had put forward the idea of taxing Bitcoins as capital assets. As previously mentioned, implementing such a strategy would solely be important for point-of-exchange transactions, for which cryptocurrency users willingly divulge their income from beneath their blanket of cyber-secrecy (Marian, 2013). More radical approaches to weaken the rise in the pre-eminence of cryptocurrencies is to operate against cryptocurrency users and/or to implement an outright ban on its usage. If such a method were to be implemented, legislators could potentially strive to dampen the enthusiasm surrounding cryptocurrencies by precluding the implementation of transactions in cryptocurrencies. While such an approach falls short of accosting the matter of tax circumvention explicitly, inhibiting payments in cryptocurrencies could undermine the liquidity and value of cryptocurrencies, and as a result, undermine their effectiveness for tax-evasion objectives. Such outsmarting approaches could likely metamorphose into the erosion of social privileges that come along with cryptocurrencies (Plassaras, 2013). One country that implemented an outright ban on the usage of cryptocurrencies within its jurisdiction in Nigeria. On the other hand, Venezuela attempted to aggressively support the usage of cryptocurrency within its jurisdiction in the wake of the precipitous collapse of its national currency. There could be plausible factors that support the necessity to allow cryptocurrencies to freely circulate, even though they are equally applied in facilitating illegal transactions. In the final analysis, We believe that consideration for one or more of the solutions proposed above could be an interesting way to initiate deliberations for the most appropriate approaches to implement fiscal policy in the face of private money reality.

5. Conclusions

Starting from a general framework and based on certain assumptions, we analyse a one-country economy featuring a cryptocurrency and a national currency. For the standard situation in which there are no uncertainties, perfectly competitive markets, and utility maximization by households from the consumption of both private and public goods and usage of both the crypto and national currencies in an economy for certain purposes, we demonstrated that government purchases are decreasing with increasing households' adoption of cryptocurrency but increasing with the returns in private money. we discussed the possibility that the fiscal policy of a government stands a chance of encountering a substantial reduction in its effectiveness if private money is allowed to coexist with public money devoid of any restrictions and we chronicled

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potential ways the over exuberance of cryptocurrencies can be clamped down. In the appendix, we demonstrated our results by specifying the household's optimal behaviour, the firm's profit-maximizing behaviour, and the general equilibrium. We,, therefore, conclude that the incorporation of unrestricted usage of a cryptocurrency in an economy may substantially impact the landscape of a nation's fiscal policy, but this unfavourable impact can also be potentially neutralized by positive feedback effects that can emanate from returns earned on a cryptocurrency.

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8. APPENDIX

8.1 Proof of Main Results

8.1.1 Optimal Household's Behavior

Households derive utility from the consumption of both private and public goods.

The households' optimization problem is to maximize their utility subject to income constraints.

$$\text{Max } U = \sum_{t=0}^{\infty} \beta^t u(C_t^p, C_t^g)$$

Subject to:

$$C_t^g + X_t = tW_tL_t + B_t \quad (1)$$

$$P_tC_t^p + M_{t+1} + m_{t+1} + B_{t+1} + P_tI_t^k = (1-t)W_tL_t + R_tP_tK_t + (1+r_t)B_t + M_t + (1+r_t^m)m_t + X_t \quad (2)$$

$$K_{t+1} = (1-\delta)K_t + I_t^k \quad (3)$$

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$$n_t M_t = m_t \quad (4)$$

Rearranging equation (3), we have the following equation:

$$I_t^k = K_{t+1} - K_t + \delta K_t \quad (5a)$$

$$-tW_t L_t = B_t - C_t^g - X_t \quad (5b)$$

Substituting equations (4), (5a) and (5b) in equation (2), we have:

$$P_t C_p^t + M_{t+1} + m_{t+1} + B_{t+1} + P_t(K_{t+1} - K_t + \delta K_t) = W_t L_t + R_t P_t K_t + (2+r_t)B_t + (1+n_t)M_t + r_t^m m_t - C_t^g$$

$$P_t C_p^t + M_{t+1} + m_{t+1} + B_{t+1} + P_t K_{t+1} = W_t L_t + R_t P_t K_t + P_t K_t - \delta P_t K_t + (2+r_t)B_t + (1+n_t)M_t + r_t^m m_t - C_t^g$$

$$P_t C_t^p + C_t^g + M_{t+1} + m_{t+1} + B_{t+1} + P_t K_{t+1} = W_t L_t + P_t K_t(1 + R_t - \delta) + (2+r_t)B_t + (1+n_t)M_t + r_t^m m_t \quad (6)$$

Substituting the household's real return on capital equation: $1 + r_t = 1 + R_t - \delta_t$ in equation (6), we have the following.

$$P_t C_t^p + C_t^g + M_{t+1} + m_{t+1} + B_{t+1} + P_t K_{t+1} = W_t L_t + (1+r_t)P_t K_t + (2+r_t)B_t + (1+n_t)M_t + r_t^m m_t \quad (7)$$

Now, we can re-write a simplified version of the household's utility maximization problem as follows.

$$\text{Max } U = \sum_{t=0}^{\infty} \beta^t u(C_t^p, C_t^g)$$

Subject to:

$$P_t C_t^p + C_t^g + M_{t+1} + m_{t+1} + B_{t+1} + P_t K_{t+1} = W_t L_t + (1+r_t)P_t K_t + (2+r_t)B_t + (1+n_t)M_t + r_t^m m_t$$

We set up the Lagrangean equation as follows:

$$L = \sum_{t=0}^{\infty} \beta^t u(C_t^p, C_t^g) + \lambda_t\{W_t L_t + (1+r_t)P_t K_t + (2+r_t)B_t + (1+n_t)M_t + r_t^m m_t - P_t C_t^p - C_t^g - M_{t+1} - m_{t+1} - B_{t+1} - P_t K_{t+1}\} \quad (8)$$

The first order conditions are as follows:

$$\frac{\partial L}{\partial C_p^t} = \beta^t \left(C_t^p\right)^{-b} - P_t \lambda_t = 0 \quad (9)$$

$$\frac{\partial L}{\partial C_g^t} = \beta^t \left(C_t^g\right)^{-b} - \lambda_t = 0 \quad (10)$$

From equation (9), we have

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$$\beta^t\left(C_t^p\right)^{-b} = P_t\lambda_t$$

$$C_t^p = \left(\frac{\beta^t}{P_t\lambda_t}\right)^{\frac{1}{b}} \quad (11)$$

Also, from equation (10), we have

$$\beta^t\left(C_t^g\right)^{-b} - \lambda_t$$

$$C_t^g = \left(\frac{\beta^t}{\lambda_t}\right)^{\frac{1}{b}} \quad (12)$$

Substituting for C_t^p and C_t^g in the budget constraint, the following results

$$P_t\left(\frac{\beta^t}{P_t\lambda_t}\right)^{\frac{1}{b}} + \left(\frac{\beta^t}{\lambda_t}\right)^{\frac{1}{b}} + M_{t+1} + m_{t+1} + B_{t+1} + P_tK_{t+1} = W_tL_t + (1+r_t)P_tK_t + (2+r_t)B_t + (1+n_t)M_t + r_t^m m_t \quad (13)$$

$$\frac{1}{\lambda_t^{\frac{1}{b}}}\left(P_t\left(\frac{\beta^t}{P_t}\right)^{\frac{1}{b}} + (\beta^t)^{\frac{1}{b}}\right) + M_{t+1} + m_{t+1} + B_{t+1} + P_tK_{t+1} = W_tL_t + (1+r_t)P_tK_t + (2+r_t)B_t + (1+n_t)M_t + r_t^m m_t$$

$$\frac{1}{\lambda_t^{\frac{1}{b}}}\left(P_t\left(\frac{\beta^t}{P_t}\right)^{\frac{1}{b}} + (\beta^t)^{\frac{1}{b}}\right) = (W_tL_t + (1+r_t)P_tK_t + (2+r_t)B_t + (1+n_t)M_t + r_t^m m_t - Mt+1 - mt+1 - Bt+1 - PtKt+1$$

$$\left(P_t\left(\frac{\beta^t}{P_t}\right)^{\frac{1}{b}} + (\beta^t)^{\frac{1}{b}}\right) = \lambda_t^{\frac{1}{b}}(W_tL_t + (1+r_t)P_tK_t + (2+r_t)B_t + (1+n_t)M_t + r_t^m m_t - Mt+1 - mt+1 - Bt+1 - PtKt+1$$

$$\lambda_t^{\frac{1}{b}} = \frac{\left(P_t\left(\frac{\beta^t}{P_t}\right)^{\frac{1}{b}} + (\beta^t)^{\frac{1}{b}}\right)}{\left(W_tL_t + (1+r_t)P_tK_t + (2+r_t)B_t + (1+n_t)M_t + r_t^m m_t - M_{t+1} - m_{t+1} - B_{t+1} - P_tK_{t+1}\right)}$$

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$$\lambda_t = \left[\frac{\left(P_t \left(\frac{\beta^t}{P_t} \right)^{\frac{1}{b}} + (\beta^t)^{\frac{1}{b}} \right)}{(W_t L_t + (1+r_t)P_t K_t + (2+r_t)B_t + (1+n_t)M_t + r_t^m m_t - M_{t+1} - m_{t+1} - B_{t+1} - P_t K_{t+1})} \right]^b \quad (14)$$

Substituting λ_t for the expression in equation (14) in equations (11) and (12), the following results:

$$C_t^p = \left(\frac{\beta^t}{P_t} \right)^{\frac{1}{b}} \left[\frac{(W_t L_t + (1+r_t)P_t K_t + (2+r_t)B_t + (1+n_t)M_t + r_t^m m_t - M_{t+1} - m_{t+1} - B_{t+1} - P_t K_{t+1})}{\left(P_t \left(\frac{\beta^t}{P_t} \right)^{\frac{1}{b}} + (\beta^t)^{\frac{1}{b}} \right)} \right]$$

$$C_t^p = \left(\frac{1}{P_t} \right)^{\frac{1}{b}} \left[\frac{(W_t L_t + (1+r_t)P_t K_t + (2+r_t)B_t + (1+n_t)M_t + r_t^m m_t - M_{t+1} - m_{t+1} - B_{t+1} - P_t K_{t+1})}{\left((P_t)^{\frac{b-1}{b}} + 1 \right)} \right] \quad (15)$$

Also,

$$C_t^g = (\beta^t)^{\frac{1}{b}} \left[\frac{(W_t L_t + (1+r_t)P_t K_t + (2+r_t)B_t + (1+n_t)M_t + r_t^m m_t - M_{t+1} - m_{t+1} - B_{t+1} - P_t K_{t+1})}{\left(P_t \left(\frac{\beta^t}{P_t} \right)^{\frac{1}{b}} + (\beta^t)^{\frac{1}{b}} \right)} \right]$$

$$C_t^g = \left[\frac{(W_t L_t + (1+r_t)P_t K_t + (2+r_t)B_t + (1+n_t)M_t + r_t^m m_t - M_{t+1} - m_{t+1} - B_{t+1} - P_t K_{t+1})}{\left((P_t)^{\frac{b-1}{b}} + 1 \right)} \right] \quad (16)$$

Equations (15) and (16) are the optimal consumption of private and public goods that maximizes the utility for the representative household.

8.1.2 Optimal Behavior of the Firm

Firms seek to maximize their profits in this economy. Given the assumption of perfectly competitive markets, firms make zero economic profits. Effectively firms seek to attain the maximum economic profits of zero.

$$\text{Max } \pi_t = P_t Y_t - W_t L_t - P_t R_t K_t \quad (17)$$

Subject to

$$Y_t = A K_t^{\alpha} L_t^{1-\alpha} \quad 0 < \alpha < 1 \quad (18)$$

When we substitute Y_t for $A K_t^{\alpha} L_t^{1-\alpha}$

$$\text{Max } \pi_t = P_t A K_t^{\alpha} L_t^{1-\alpha} - W_t L_t - P_t R_t K_t$$

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The first order conditions are:

$\frac{\partial \pi_t}{\partial K_t} = \alpha P_t A K_t^{\alpha-1} L_t^{1-\alpha} - P_t R_t = 0$

$\frac{\partial \pi_t}{\partial L_t} = (1-\alpha) P_t A K_t^{\alpha} L_t^{-\alpha} - W_t = 0$

Given $\frac{\partial \pi_t}{\partial K_t} = \alpha P_t A K_t^{\alpha-1} L_t^{1-\alpha} - P_t R_t = 0$, we have:

$\alpha P_t A K_t^{\alpha-1} L_t^{1-\alpha} = P_t R_t$

$K_t^{\alpha-1} = \frac{P_t R_t}{\alpha P_t A L_t^{1-\alpha}}$

$K_t^{\alpha-1} = \frac{R_t}{\alpha A L_t^{1-\alpha}}$

$R_t = \alpha A K_t^{\alpha-1} L_t^{1-\alpha}$ (19)

Substituting R_t for $\alpha A K_t^{\alpha-1} L_t^{1-\alpha}$ in the equation for the household's real return on capital: $1 + r_t = 1 + R_t - \delta_t$, we have the following expression.

$1 + r_t = 1 + \alpha A K_t^{\alpha-1} L_t^{1-\alpha} - \delta_t$ (20)

Given that $\frac{\partial \pi_t}{\partial L_t} = (1-\alpha) P_t A K_t^{\alpha} L_t^{-\alpha} - W_t = 0$, we have:

$W_t = (1-\alpha) P_t A K_t^{\alpha} L_t^{-\alpha}$ (21)

8.1.3 General Equilibrium

At the general equilibrium, we can postulate that the following statements hold.

The labor supply, $L_t = 1$

The profits, π_t, of the representative firm given competitive market conditions = 0

Given our assumption that public money is introduced through lump-sum transfers to consumers, then in equilibrium, $M_{t+1} = M_t + X_t$

The sum of the aggregate households' optimal demand or consumption and aggregate households' investment is equal to the aggregate optimal output. Therefore, we have the following expression:

$C_t^p + C_t^g + I_t = Y_t$

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Where, I_t is equal to the aggregate of the households' investment in firms' capital, government bonds and crypto currencies.

Thus, we have the following expression:

$$P_tC_t^p + C_t^g + m_{t+1} - m_t + P_tK_{t+1} - P_tK_t = W_tL_t + r_tP_tK_t + r_tB_t + r_t^m m_t \quad (22)$$

We understand from the equation for the household's real return on capital invested in firms that: $1 + r_t = 1 + R_t - \delta_t$, thus we have:

$$r_t = R_t - \delta_t$$

Therefore, substituting for the real return on capital in equation (22), we have the following expression:

$$P_tC_t^p + C_t^g + m_{t+1} - m_t + P_tK_{t+1} - P_tK_t = W_tL_t + (R_t - \delta_t)P_tK_t + r_tB_t + r_t^m m_t \quad (23)$$

Given equations (19) and (21) if we substitute R_t for $\alpha AK_t^{\alpha-1}L_t^{1-\alpha}$ and W_t for $(1-\alpha)P_tAK_t^{\alpha}L_t^{-\alpha}$ in equation (23), we have the following expression:

$$P_tC_t^p + C_t^g + m_{t+1} - m_t + P_tK_{t+1} - P_tK_t = (1-\alpha)P_tAK_t^{\alpha}L_t^{1-\alpha} + (\alpha AK_t^{\alpha-1}L_t^{1-\alpha} - \delta_t)P_tK_t + r_tB_t + r_t^m m_t \quad (24)$$

$$P_tC_t^p + C_t^g + = (1-\alpha)P_tAK_t^{\alpha}L_t^{1-\alpha} + (\alpha AK_t^{\alpha-1}L_t^{1-\alpha} - \delta_t)P_tK_t + r_tB_t + r_t^m m_t - (m_{t+1} - m_t) - P_tK_{t+1} + P_tK_t \quad (25)$$

$$C_t^g = \{(1-\alpha)P_tAK_t^{\alpha}L_t^{1-\alpha} + (\alpha AK_t^{\alpha-1}L_t^{1-\alpha} - \delta_t)P_tK_t + r_tB_t + r_t^m m_t - (m_{t+1} - m_t) - P_tK_{t+1} + P_tK_t\} - P_tC_t^p \quad (26)$$

If we substitute C_t^p for the expression below:

$$\left(\frac{1}{P_t}\right)^{\frac{1}{b}}\left[\frac{(W_tL_t + (1+r_t)P_tK_t + (2+r_t)B_t + (1+n_t)M_t + r_t^m m_t - M_{t+1} - m_{t+1} - B_{t+1} - P_tK_{t+1})}{\left((P_t)^{\frac{b-1}{b}} + 1\right)}\right]$$,the following results:

$$C_t^g = \{(1-\alpha)P_tAK_t^{\alpha}L_t^{1-\alpha} + (\alpha AK_t^{\alpha-1}L_t^{1-\alpha} - \delta_t)P_tK_t + r_tB_t + r_t^m m_t - (m_{t+1} - m_t) - P_tK_{t+1} + P_tK_t\} - P_t\left(\left(\frac{1}{P_t}\right)^{\frac{1}{b}}\left[\frac{(W_tL_t + (1+r_t)P_tK_t + (2+r_t)B_t + (1+n_t)M_t + r_t^m m_t - M_{t+1} - m_{t+1} - B_{t+1} - P_tK_{t+1})}{\left((P_t)^{\frac{b-1}{b}} + 1\right)}\right]\right)$$

$$C_t^g = \{(1-\alpha)P_tAK_t^{\alpha}L_t^{1-\alpha} + (\alpha AK_t^{\alpha-1}L_t^{1-\alpha} - \delta_t)P_tK_t + r_tB_t + r_t^m m_t - (m_{t+1} - m_t) - P_tK_{t+1} + P_tK_t\} - \left((P_t)^{\frac{b-1}{b}}\left[\frac{(W_tL_t + (1+r_t)P_tK_t + (2+r_t)B_t + (1+n_t)M_t + r_t^m m_t - M_{t+1} - m_{t+1} - B_{t+1} - P_tK_{t+1})}{\left((P_t)^{\frac{b-1}{b}} + 1\right)}\right]\right) \quad (27)$$

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Equation (27) is the demand for public goods at the general equilibrium.

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